

WHAT IS CLAIMED IS:

1. A photodiode, comprising in an active region surrounded by a device isolating part formed adjacent to a main surface of a semiconductor substrate:

5 a first region which is extended inward from said main surface and is of a first conduction type;

 a second region which is separated from said device isolating part and is extended from said main surface into said first region and which is of a second conduction type different
10 from the first conduction type; and

 a third region which is extended into said first region in such a way to be in contact with said main surface and said second region and which is of the first conduction type having an impurity concentration higher than said first region.

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2. The photodiode as claimed in claim 1, wherein said third region substantially surrounds said second region.

3. The photodiode as claimed in claim 1, wherein an interface
20 between said second region and said third region in said semiconductor substrate is covered with an insulation film formed by a thermal oxidation method.

4. The photodiode as claimed in claim 1, wherein a distance
25 between said second region and said device isolating part is larger than a width of a depletion layer which is spreading from an interface between said second region and said third region toward said device isolating part.

5. The photodiode as claimed in claim 1, wherein said third region is extended along a surface opposite to said main surface of said second region.

5 6. The photodiode as claimed in claim 1, wherein said third region is in contact with said device isolating part.

7. An image sensor having a pixel of a light receiving part, said pixel comprising:

10 a photodiode including in an active region surrounded by a device isolating part formed adjacent to a main surface of a semiconductor substrate: a first region which is extended inward from said main surface and is of a first conduction type; a second region which is separated from said device
15 isolating part and is extended from said main surface into said first region and which is of a second conduction type different from the first conduction type; and a third region which is extended into said first region in such a way to be in contact with said main surface and said second region and which is of
20 the first conduction type having an impurity concentration higher than said first region; and

a field effect transistor having a fourth region which is formed in said active region and constructs a source and a drain, one of which is joined to said second region of said
25 photodiode, and which is of the second conduction type.

8. The image sensor as claimed in claim 7, wherein a part of said second region also serves as said fourth region.

9. The image sensor as claimed in claim 7, wherein said third region substantially surrounds said second region.

10. The image sensor as claimed in claim 7, wherein said third
5 region is arranged at a location away from a gate electrode of said field effect transistor with at least a distance of diffusion length of said third region.

11. The image sensor as claimed in claim 7, wherein said third
10 region substantially surrounds said second region and said fourth region.

12. The image sensor as claimed in claim 7, wherein an
interface between said second region and said third region in
15 said semiconductor substrate is covered with an insulation film formed by a thermal oxidation method.

13. The image sensor as claimed in claim 12, wherein said
insulation film is the same layer as a gate insulation film of
20 said field effect transistor.

14. The photodiode as claimed in claim 7, wherein a distance
between said second region and said device isolating part is
larger than a width of a depletion layer which is spreading
25 from an interface between said second region and said third region to said device isolating part.

15. The photodiode as claimed in claim 7, wherein said third region is extended along a surface opposite to said main

surface of said second region.

16. The photodiode as claimed in claim 7, wherein said second region and said fourth region are formed by the same process.

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17. A photodiode, comprising in an active region surrounded by a device isolating part formed adjacent to a main surface of a semiconductor substrate:

10 a first region which is exposed to said main surface and is of a first conduction type;

a second region which is separated from said device isolating part and is exposed to said main surface and which is formed in said first region and has an impurity concentration higher than said first region; and

15 a third region which is located at a position where said device isolating part is close to said second region, which is in contact with said main surface, said device isolating part, said first region and said second region and which is of the first conduction type having an impurity concentration higher
20 than said first region.

18. An image sensor having a pixel of a light receiving part, said pixel comprising:

25 a photodiode including in an active region surrounded by a device isolating part formed adjacent to a main surface of a semiconductor substrate: a first region which is exposed to said main surface and is of a first conduction type; a second region which is separated from said device isolating part and is exposed to said main surface and which is formed in said

first region and has an impurity concentration higher than said first region; and a third region which is located at a position where said device isolating part is close to said second region, which is in contact with said main surface, said device

5 isolating part, said first region and said second region and which is of the first conduction type having an impurity concentration higher than said first region; and

a field effect transistor having a fourth region which is formed in said active region and constructs a source and a
10 drain, one of which is joined to said second region of said photodiode, and which is of the second conduction type.